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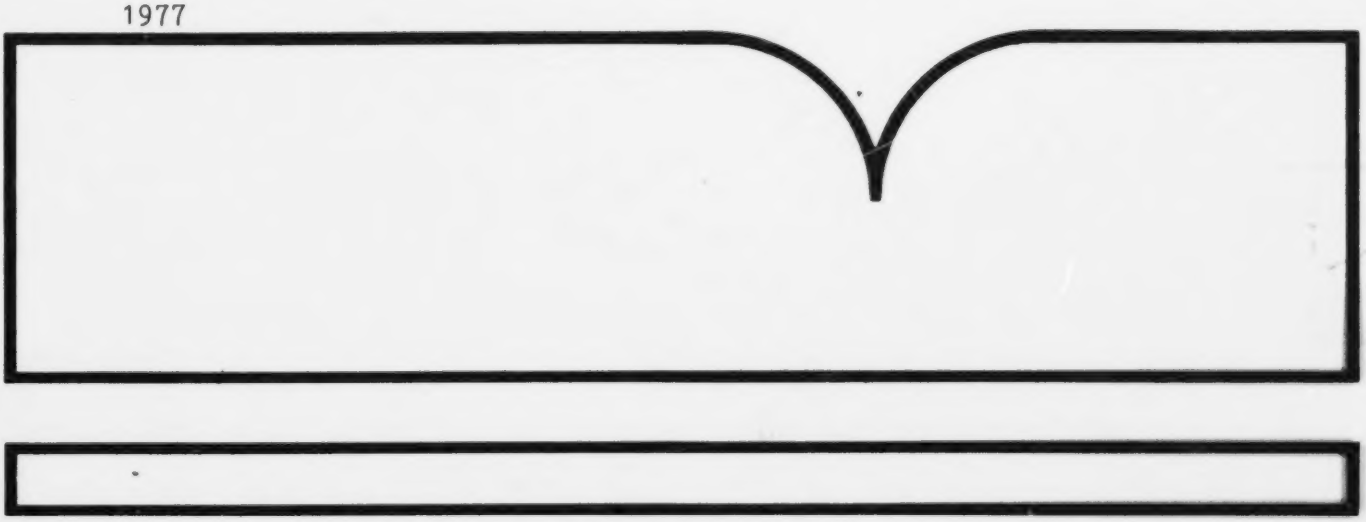

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The leeches of the Great Lakes region compose a significant part of the North American freshwater fauna in numbers of species (43 taxa) and are considered biologically important as parasites and predators. Recently, several studies (Klemm, 1972a, 1973, 1974, 1975, 1976; Kopenski, 1969, 1972) concentrated on the leeches of Michigan while others, mainly Sawyer (1972), included the Great Lakes region and the whole of North America. Consequently, the leeches of the Great Lakes region are faily well known. Yet studies of leeches, in general, have received too little attention largely due to problems in species identification. This difficulty was caused by the inadequate information in most early taxonomic descriptions which were brief and ambiguous, lacked internal morphological characterization, often were concerned only with superficial characters, or were based on too few specimens.

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JOURNAL ARTICLE

A Review of the Leeches (Annelida: Hirudinea) in the Great Lakes Region

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Introduction

The leeches of the Great Lakes region compose a significant part of the North American freshwater fauna in numbers of species (43 taxa) and are considered biologically important as parasites and predators. Recently, several studies (Klemm, 1972a, 1973, 1974, 1975, 1976; Kopenski, 1969, 1972) concentrated on the leeches of Michigan, while others, mainly Sawyer (1972), included the Great Lakes region and the whole of North America. Consequently, the leeches of the Great Lakes region are fairly well known. Yet studies of leeches, in general, have received too little attention largely due to problems in species identification. This difficulty was caused by the inadequate information in most early taxonomic descriptions which were brief and ambiguous, lacked internal morphological characterization, often were concerned only with superficial characters, or were based on too few specimens. In recently published keys (Davies, 1971; Klemm, 1972b, 1976, 1977; Sawyer, 1972; Sawyer *et al.*, 1975; Sawyer and Shelley, 1976) and in a biochemical approach to leech taxonomy (Khan and McT. Cowan, 1976), attempts have been made to eliminate

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problems of identification and taxonomic confusion. However, some problems still exist.

Knowledge of leech ecology is also sketchy. Accounts of Herrmann (1970), Kenk (1949), Klemm (1972a), Kopenski (1969), and Sapkarev (1968) have, nevertheless, been helpful. Also, the following biological and faunistic studies for the Great Lakes region have added some information: Bere (1931), Davies (1973), Keith (1954), Miller (1929, 1937), Meyer (1937, 1940, 1946), Meyer and Moore (1954), Moore (1901, 1906, 1912, 1920, 1922a, 1922b, 1923, 1924, 1936), Poe (1972), Richmond (1972), Sarah (1971), and Sawyer (1968, 1970). Detailed lists on the distribution of North American leeches (Klemm, 1972b, 1975, 1976, 1977; Sawyer, 1972; Davies, 1973; Sawyer *et al.*, 1975, and Sawyer and Shelley, 1976) and factors influencing species distribution (Herrmann, 1970; Klemm, 1972a, 1974, 1975, 1976; Sawyer, 1972, 1974; Sawyer *et al.*, 1975, Sawyer and Shelley, 1976) have, in addition, helped with our understanding of leech biology. The literature also indicates that there is very little specific information on the pollution ecology of the Great Lakes leeches. Sawyer (1974) provides an excellent review covering the relationships of leeches, in general, to normal factors of the environment and their responses to various kinds of pollution.

This paper is intended to update and provide new information on the current taxonomy of the Great Lakes species as well as to indicate the distribution of the leeches in that region. The data are based on literature and the author's collection and examination of approximately 4,000 specimens from the Great Lakes region and bordering states of Illinois, Indiana, Michigan, Minnesota, Ohio, New York, Pennsylvania, and Wisconsin in the United States and the Province of Ontario in Canada. Forty-three species are recorded from the Great Lakes region (Table I).

The taxonomy follows primarily that of Klemm (1972a, 1976, 1977) but includes also variations proposed by Sawyer (1972), Sawyer *et al.* (1975), and Sawyer and Shelley (1976). Two exceptions proposed in this paper are that *Helobdella lineata* (Verrill, 1874) be relegated to synonymy under *H. triserialis* (E. Blanchard, 1849) and that *Theromyzon biannulatum* nom. nov. (for *occidentalis* [Moore, 1912], *nec* [Verrill, 1874]) be erected. Only those species of the Great Lakes region whose taxonomic and distribution status are in doubt are discussed.

Results and Discussion

Taxonomy

The order Rhynchobdellida is represented by two families, Glossiphoniidae and Piscicolidae. Seven genera and 22 species of Glossi-

TABLE I
LEECHES OF THE GREAT LAKES REGION

Order RHYNCHOBDELLIDA

Family GLOSSIPHONIIDAE

Actinobdella annectens Moore, 1906
A. inequiannulata Moore, 1901 [=*triannulata* Moore, 1924]
Batracobdella michiganensis Sawyer, 1972
B. phalera (Graf, 1899)
B. picta (Verrill, 1872)
Glossiphonia complanata (Linnaeus, 1758)
G. heteroclita (Linnaeus, 1761)
Helobdella elongata (Castle, 1900)
H. fusca (Castle, 1900)
H. papillata (Moore, 1906)
H. stagnalis (Linnaeus, 1758)
H. transversa Sawyer, 1972
H. triserialis (E. Blanchard, 1849) [=*lineata* (Verrill, 1874)]
Marvinmeyeria [=*Oculobdella*] *lucida* (Moore, 1954)
Placobdella hollensis (Whitman, 1892)
P. montifera Moore, 1906
P. ornata (Verrill, 1872)
P. papillifera (Verrill, 1872)
P. parasitica (Say, 1824)
P. pediculata Hemingway, 1908
Theromyzon biannulatum nom. nov. [=*occidentalis* (Moore, 1912), *nec* (Verrill, 1874)]
T. rude (Baird, 1869)[1]

Family PISCICOLIDAE

Cystobranchus meyeri Hayunga & Grey, 1976
C. verrilli Meyer, 1940
Myzobdella lugubris Leidy, 1851 [=*Illinobdella alba* Meyer, 1940; *I. elongata* Meyer, 1940; *I. moorei* Meyer, 1940; *I. richardsoni* Meyer, 1940]
Piscicola geometra (Linnaeus, 1758)[2]
P. milneri (Verrill, 1874)
P. punctata (Verrill, 1871)
Piscicolaria reducta Meyer, 1940

Order PHARYNGOBDELLIDA

Family ERPOBDELLIDAE

Dina dubia Moore & Meyer 1951

TABLE I (continued)

D. parva Moore, 1912
Erpobdella punctata (Leidy, 1870)
Mooreobdella bucera (Moore, 1949)
M. fervida (Verrill, 1874)
M. microstoma (Moore, 1901)
Nephelopsis obscura Verrill, 1872

Order GNATHOBDELLIDA

Family HIRUDINIDAE

Haemopis [=*Mollibdella*] *grandis* (Verrill, 1874)
H. [=*Percymoorensis*] *lateromaculata* Mathers, 1963
H. [=*Percymoorensis*] *marmorata* (Say, 1824) Moore, 1901
H. [=*Bdellarogatis*] *plumbea* Moore, 1912
H. [=*Percymoorensis*] *terrestris* (Forbes, 1890) Sawyer, 1972
Macrobdella decora (Say, 1824)
Philobdella gracilis Moore, 1901

[1]Questionable distribution record in Great Lakes region.
[2]Questionable occurrence in North America (Sawyer, 1972).

phoniidae have been recorded from the Great Lakes region (Table I). A survey of the literature revealed that the taxonomic status of two species in *Actinobdella*, two species in *Theromyzon*, and three species of *Helobdella* is questionable.

In a critical study Daniels (1975, unpublished data and 1976), reporting on the biology of *Actinobdella inequiannulata* Moore (1901), found that morphologically the large series of specimens he studied and some of the types resembled descriptions of both *A. triannulata* Moore (1924) and *A. inequiannulata*. He established that there is only one species, *A. inequiannulata*.

A similar problem also exists in the genus *Theromyzon*, and various nominal species have undergone considerable synonymy (Soós, 1969). Confusion still exists in the taxonomy of the North American species of *Theromyzon*. Their identification is based mainly on the number of annuli (two, three, or four) between the male and female gonopores. This study and Sawyer (personal communication) have postulated that the validity of taxonomically separating species on the basis of the number of annuli between gonopores alone is questionable. Meyer and Moore (1954, p. 58) anticipated this outcome by observing that the annular separation of the gonopores in *T. rude* varies.

The first reported species of *Theromyzon* from North America was

T. rude. It was briefly described by Baird (1869) from Great Bear Lake, Northwest Territories, Canada. Not until the studies by Moore and Meyer (1951) and Meyer and Moore (1954) was its complete anatomy made known. It was described as having gonopores separated by three annuli. Moreover, in 1951, Moore and Meyer indicated that *T. rude* was a species characteristic of waterfowl flyways of the Rocky Mountain, Great Basin, and Central Canada regions. Chronologically, *T. occidentalis* Verrill (1874) is the second species described in the genus. Verrill's description of the type specimen (collected from Colorado) was brief and wanting in sufficient detail. In 1912, Moore, based on material from Minnesota and elsewhere, emended the description of Verrill and characterized a form bearing the name *occidentalis* as having two annuli between the gonopores. However, Moore (1912, 1952) indicated that it is not at all certain that his specimens were really Verrill's *occidentalis*. This form from Minnesota is probably the same as the North American records of *T. meyeri* (Livanow, 1902), also characterized by a two annuli separation between gonopores. *Theromyzon meyeri*, originally described from Europe, was considered by some authors (Moore, 1922a, 1959; Mann, 1962; Sawyer, 1972) to be more characteristic of the Upper Mississippi Valley States.

The description of *T. rude* in Moore and Meyer (1951) and Meyer and Moore (1954) suggested, therefore, that Verrill's *T. occidentalis* (type lost) from Southern Colorado should be considered synonymous under *T. rude*. Soós (1969) corroborated this conclusion by synonymizing Verrill's (1874) *occidentalis* (and Moore's [1912] form of *occidentalis*) with *T. rude*, a taxon with three annuli between the gonopores. Also, in 1969, Soós proposed that, following rules of priority, the European *T. meyeri* be relegated to synonymy under *T. maculosum* (Rathke, 1862), also a European species. Later Davies (1971, 1972, 1973) and Klemm (1972a, 1972b) recognized the synonymies of Soós (1969) for both *T. maculosum* and *T. rude*. However, it has not been established that *T. maculosum* with the two annuli between the gonopores and unique pigmentation pattern occurs in North America. Additional study of Moore's (1912) description of *occidentalis* from the Minnesota collection and later reported to occur there by Keith (1954) has convinced me and Sawyer (personal communication) that this leech is neither *T. rude* nor *T. maculosum*. Therefore, if we are correct, Moore's species requires a new specific name. I propose the name *T. biannulatum* nom. nov. for Moore's (1912) *occidentalis*, *nec* Verrill (1874), the only known representative of *Theromyzon* from North America with two annuli between the gonopores. The following is Moore's (1912) description:

Theromyzon biannulatum nom. nov. [= for *occidentalis* (Moore, 1912), *nec* (Verrill, 1874)]

There are four pairs of large conspicuous eyes, which cannot be mistaken for the much smaller ones of *Placobdella hollensis*. They are situated on somites *II* to *V* respectively; the first is the smallest and very close together or even in actual contact, the others are successively more distant and the third pair is the largest. The first and second are directed forward, the third and fourth backwards and outward.

The upper lip is very mobile and in preserved examples is almost invariably curled into the cavity of the sucker. The small mouth is far forward in somite *II*. Genital orifices occur at the positions so frequent in the Glossiphoniidae, the male at *XI/XII*, the female at *XII a2/a3*. In one specimen the male bursa is everted in the form of a short conical penis, this being the only species of the family described in this paper in which such an organ is present.

Besides the numerous scattered sense organs which roughen the skin there are three pairs of low dome-shaped papillae on each neural annulus except at the anterior end of the body. Apparently these bear the dorso-median, dorso-lateral and dorso-marginal sensillae, the first of which are separated by about one-fourth of the width of the body.

With the exception of somites *X*, *XI* and *XII*, on which they cannot be detected nephridiopores occur on *a2* of every somite from *VIII* to *XXV*. Very little is known of the internal anatomy of this species but quite enough to establish its position as a member of the genus. The proboscis is very short and is succeeded immediately by a very short oesophagus and a long stomach which bears nine pairs of branched caeca, two of which are anterior to the reproductive orifices and the last reflected in the usual manner. The muscular system is very peculiar in the wide intervals which exist between the bundles of muscle fibers.

The color of preserved specimens is a translucent grayish green, the dorsum being rather thickly spotted with cream yellow, the largest spots corresponding with the six series of papillae described above.

The annulation presented in figure 12 should not be taken as fully characteristic of the species as it exhibits the somites in the undeveloped biannulate or nearly biannulate condition which is observed in the young of all species. With a more pronounced development of the furrows between *a1* and *a2* it would, however, be diagnostic. In the adult somite I is a distinct but small preocular lobe, II nearly and IV fully biannulate. A very interesting feature, which is found in all of these young and in the few adults which I have studied, is that somite *V* is shorter and much less elaborate than *IV*. Somite *VI* approaches the triannulate type very closely and *VII* to *XXIV* inclusive are completely triannulate; their annuli and furrows are all equal. Finally *XXV* is biannulate, *XXVI* biannulate or uniannulate and *XXVII* uniannulate.

A fourth species, *T. tessulatum* (O.F. Muller, 1774), typically Eurasian, is not found in the Great Lakes region but is considered by some authors to be holarctic. This species has four annuli between the gonopores. It has been reported, however, by Herrmann (1970) in Colorado and from Canada by Pawlowski (1948), Oliver (1958), and Davies (1973). Whether these authors were actually looking at a variant of *T. rude* is uncertain. The presence of *T. tessulatum* in North America has never been unequivocally demonstrated.

Species of *Theromyzon* normally parasitize waterfowl. Specimens taken from ducks are usually so engorged that they appear as small sacs of blood with their body walls so tightly stretched that species identification is often impossible to determine (Moore and Meyer, 1951). In the future, a critical examination of the internal anatomy of the various species of *Theromyzon* and a comparison of the annuli between the gonopores of specimens from one population and from different geographical ranges may show that only one or two species exist and that their distribution may not necessarily be correlated with the different waterfowl flyways. Until these problems are critically examined, it is best to consider the three American *Theromyzon* taxa as *T. biannulatum* nom. nov. (with two annuli separating the gonopores), *T. rude* (with three annuli between the gonopores), and *T. tessulatum* (gonopores separated by four annuli).

In the genus *Helobdella* variation due to polymorphism of taxonomic characters is known to occur in *Hellobdella fusca*, *H. triserialis* [=*lineata*] in North America and in *H. punctatolineata* Moore (1939) from the Dominican Republic, Jamaica, and Puerto Rico, and criteria for their separation may actually be based on polymorphism. Specimens that resemble *H. punctatolineata* have been reported from the Great Lakes region (Sapkarev, 1968; Richmond, 1972; and Klemm, 1974, 1975, 1976), but these records are now believed doubtful. However, this species may prove to be a variant of the *H. triserialis* complex.

Soós (1969) proposed that *H. fusca* (Castle, 1900) and *H. lineata* be placed in synonymy under *H. triserialis*. Klemm (1972a, 1972b, 1974, 1975, 1976), Sawyer (1972), and Sawyer and Shelley (1976) maintained both *H. fusca* and *H. lineata* as distinct species. Based on the critical works of Ringuelet (1943, 1944a, 1944b, 1945) and an examination of several hundred specimens, it is now proposed that *H. lineata* be relegated to synonymy under *H. triserialis* but that *H. fusca* remain a distinct species until the problem of polymorphism is settled.

In the family Piscicolidae four genera and seven species are reported from the Great Lakes region (Table I). The species of *Illinobdella alba* (Meyer, 1940), *I. elongata* (Meyer, 1940), *I. moorei* (Meyer,

1940), and *I. richardsoni* (Meyer, 1940) have been the subject of much confusion. Some anatomical features of the freshwater species, *I. moorei*, and the brackish water inhabitant, *Myzobdella lugubris* Leidy (1851), have been known for some time (Meyer, 1940, 1946; Moore, 1946), and the species were distinguished mainly on the basis of their habitats. Recent evidence by Daniels and Sawyer (1975) showed that the ecological differences between the two species were not as great as had been assumed earlier. Therefore, Sawyer *et al.* (1975), based on additional anatomical evidence, synonymized *I. alba*, *I. elongata*, *I. moorei*, and *I. richardsoni*, under *M. lugubris*.

Confusion also exists between the species *Piscicola milneria* (Verrill, 1874) and *P. geometra* (Linnaeus, 1758). These two species are separated taxonomically by the number of oculiform spots and presence (or absence) of dark pigment rays on the posterior sucker. These two species cannot always be satisfactorily distinguished from one another on the basis of these characters. A critical examination of their internal anatomy is needed for these two species.

In the family Erpobdellidae (Order Pharyngobdellida) four genera and seven species are recorded from the Great Lakes region (Table I). Soós (1963, 1966) and Sawyer (1972) pointed out that the taxonomic rank of certain erpobdellid groups underwent a number of changes over the years and that they still remain unsettled even today. Some of the confusion has been in the use of certain taxonomic characters, i.e. annulation between gonopores, the presence (or absence) of pre-atrial loops of the vas deferens of the reproductive system, and especially the enlargement and subdivision of b_6 annulus of complete somites.

In North America species of *Dina* are closely related to *Erpobdella* in that both have long pre-atrial loops of the vas deferens. In the past *Dina* was distinguished from *Erpobdella* on the basis of the enlarged and subdivided b_6 annulus. Species of *Mooreobdella* also were characterized with the enlarged and subdivided b_6 annulus and were considered closely related to *Dina*. However, *Mooreobdella* differs from both *Dina* and *Erpobdella* by the lack of long pre-atrial loops of the vas deferens. It should be made clear that the subdivision of the annulus is usually difficult to distinguish from wrinkles in preserved specimens of *Dina*, *Erpobdella*, and *Mooreobdella* and is, therefore, a poor diagnostic character. Until someone critically looks at the taxonomic standing of the North American *Dina*, species *dubia* and *parva*, it is best for now left alone.

Based on taxonomic interpretation, Pawlowski (1955) removed *Dina bucera*, *D. fervida*, and *D. microstoma* and placed them in the new genus, *Mooreobdella*. Moore (1959) subsequently recognized

Mooreobdella as a distinct genus. The generic standing of *Mooreobdella* for the species *bucera*, *fervida*, and *microstoma* is now generally accepted.

In the Family Hirudinidae (Order Gnathobdellida) three genera and seven species are included in the Great Lakes region fauna (Table I). Davies (1971, 1972, 1973) and Klemm (1972a, 1972b) uncritically followed the recent revision of the Genus *Haemopis* by Richardson (1969), who established several new genera, *Bdellarogatis*, *Mollibdella*, and *Percymoorensis*. Sawyer (1972) and Sawyer and Shelley (1976) were forced to reject Richardson's revision based on additional anatomical information. In light of the studies by Sawyer (1972) and Sawyer and Shelley (1976), the traditional Genus, *Haemopis*, remains the only one acceptable and includes the Great Lakes species: *grandis*, *lateromaculata*, *marmorata*, *plumbea*, and *terrestris*. Of these species Sawyer (1972) indicates that very little is known about the systematic standing of *H. plumbea* except that it differs in internal anatomy from *H. grandis* and *H. marmorata*, but it may closely resemble them externally.

Distribution

Since the literature is widely scattered and fragmentary and based on limited collections, it is often difficult to obtain valid information on species distribution. Also, some of the published records are inaccurate. In contrast, the distribution of species in Tables II, III, IV, and V are considered valid and accurate. They are based on the author's collection, on literature considered valid, on identification or verification of specimens by the author, and on distribution data from reliable collectors and museums. As noted in the "Taxonomy Section," *Theromyzon rude* may not occur in the Great Lakes region, and the occurrence of *Piscicola geometra* in North America is questionable.

The data summarized in Tables II-V may indicate that the number of species recorded from the Great Lakes region are regulated mainly by ecological factors (Klemm, 1972a, 1974, 1975, 1976 and Sawyer, 1972, 1974) but also may reflect, in part, the number of sites examined and the time spent collecting. Michigan and Ontario have the highest number of recorded species, i.e. 39 and 33 respectively. The next highest numbers are in Illinois with 30, Minnesota with 28, and Wisconsin with 28. Following closely are New York with 26, Ohio with 23, and Pennsylvania with 22 species recorded. Indiana appears to be the most neglected area with only 15 species reported. However, additional collecting will undoubtedly extend the distribution of some of the species.

TABLE II
SUMMARY OF DISTRIBUTION OF GLOSSIPHONIIDAE IN THE GREAT LAKES REGION

Species	Ontario	Ill.	Ind.	Mich.	Minn.	N.Y.	Ohio	Penn.	Wisc.
Family GLOSSIPHONIIDAE									
Actinobdella annectens	+								
A. inequiannulata	+	+		+	+	*	+	*	
Batracobdella michiganensis				+					
B. phalera	+	+		+	+	+	+	*	+
B. picta	+	+		+		+	+		+
Glossiphonia complanata	+	+	+	+	+	+	+	+	+
G. heteroclita	+	+	+	+		*	+	+	+
Helobdella elongata	+	+	+	+	+	+	+	+	+
H. fusca	+	+	+	+	+	*	+	+	+
H. papillata	+	+		+	+		+		+

H. stagnalis	+	+	+	+	+	+	+	+	+
H. transversa				+					
H. triserialis	+	+		+	+	*	+	+	+
Marvinmeyeria lucida				+					
Placobdella hollensis	+			+	+				+
P. montifera	+	+	+	+	+	+	+	*	+
P. ornata	+	+	+	+	+	+	+	+	+
P. papillifera	+	+		+				*	
P. parasitica	+	+	+	+	+	+	+	+	+
P. pediculata		+			+				+
Theromyzon biannulatum		+		+	+			+	
T. rude				+[1]					
Total	16	16	8	20	14	12	13	13	14

*New record.
[1]See Table 1.

TABLE III
SUMMARY OF DISTRIBUTION OF PISCICOLIDAE IN THE GREAT LAKES REGION

Species	Ontario	Ill.	Ind.	Mich.	Minn.	N.Y.	Ohio	Penn.	Wisc.
Family PISCICOLIDAE									
Cystobranchus meyeri						+			
C. verrilli	+	+		+					
Myzobdella lugubris	+	+	+	+	+	+	+	+	+
Piscicola geometra	+[1]			+[1]	+[1]	+[1]			+[1]
P. milneri	+	+		+	+	+		*	+
P. punctata	+	+		+	+	+	+	+	+
Piscicolaria reducta	+	+		+	*	*		*	+
Total	6	5	1	6	5	6	2	4	5

*New record.
[1]See Table I.

TABLE IV
SUMMARY OF DISTRIBUTION OF ERPOBDELLIDAE IN THE GREAT LAKES REGION

Species	Ontario	Ill.	Ind.	Mich.	Minn.	N.Y.	Ohio	Penn.	Wisc.
Family ERPOBDELLIDAE									
Dina dubia	+	+	+	+					
D. parva	+	+	+	+	+	+			+
Erpobdella punctata	+	+	+	+	+	+	+	+	+
Mooreobdella bucera				+					
M. fervida	+	+	+	+	+	+	+	+	+
M. microstoma	+	+	+	+		+	+	+	+
Nephelopsis obscura	+			+	+	+			+
Total	6	5	5	7	4	5	3	3	5

TABLE V
SUMMARY OF DISTRIBUTION OF HIRUDINIDAE IN THE GREAT LAKES REGION

Species	Ontario	Ill.	Ind.	Mich.	Minn.	N.Y.	Ohio	Penn.	Wisc.
Family HIRUDINIDAE									
Haemopis grandis	+			+	+	+	+		+
H. lateromaculata					+				
H. marmorata	+	+	+	+	+	+	+	+	+
H. plumbea	+[1]			+[1]	+		+[1]		+[1]
H. terrestris	+	+		+			+		
Macrobdella decora	+	+		+	+	+	+	+	+
Philobdella gracilis		+		+					
Total	5	4	1	6	5	3	5	2	4

[1]Questionable distribution records.

In the family Glossiphoniidae (Table II), *Glossiphonia complanata, Helobdella stagnalis, Placobdella ornata, P. parasitica* are very common in some localities and are widely distributed in the Great Lakes region. *Helobdella elongata, H. fusca,* and *H. triserialis* are common and widely distributed and may be locally abundant. *Helobdella triserialis* is especially abundant in the southern states while *H. fusca* is a more northern species but their ranges partly overlap. *Batracobdella picta, Placobdella hollensis, P. papillifera* are common in some areas and uncommon elsewhere but may be locally abundant. *Placobdella montifera, Batracobdella phalera, Glossiphonia heteroclita, Helobdella papillata, Actinobdella inequiannulata* are uncommon, widely distributed, but may be locally abundant. *Placobdella pediculata, Marvinmeyeria lucida, Actinobdella annectens, Batracobdella michiganensis, Helobdella transversa, Theromyzon biannulatum,* and *T. rude* are uncommon and more restricted in distribution, some having been reported only from a single area.

Theromyzon biannulatum is uncommon but may be locally abundant. Published records believed valid for *T. biannulatum* are Moore (1912), Keith (1954), Sawyer (1972) [=their *T. meyeri*] and Klemm (1972a, 1972b) [=their *T. maculosum*]. The occurrence of *T. rude* in the Great Lakes region is based on several collections (Klemm, 1972a, 1972b; Kopenski, 1972). These distribution records may easily be explained by the fact that species of *Theromyzon* are waterfowl parasites and are carried in the nares and nasal passages of many migratory waterfowl. Further studies may also show that the forms of *T. rude* reported in the Great Lakes region are only variant forms of *T. biannulatum*. Other authors who have reported *T. rude* are: Keith (1955) from Alaska, Herrmann (1970) from Colorado, and from Canada Bere (1929); Fredeen and Shemanchuk (1960); Oliver (1958); Rawson and Moore, J. E. (1944); Moore, J. E. (1964, 1966); Scudder and Mann (1968); Scudder (1969); Davies (1973); and Bartonek and Trauger (1975). A species of *Theromyzon*, thought to be *T. meyeri* (see Taxonomy) has previously been reported from South Dakota (Moore and Meyer, 1951), Iowa (Sooter, 1937; Mathers, 1948) and from Alberta, Canada (Moore, J. E., 1964, 1966). Some of these records may be confused with the species *T. rude* or *T. biannulatum*.

The family Piscicolidae (Table III) contains leeches that parasitize a great variety of fishes. *Myzobdella lugubris* appears very common and widely distributed. *Piscicola milneri, P. punctata,* and *Piscicolaria reducta,* however, are uncommon and widely distributed but may be locally abundant. They have not been reported from Indiana, and of these only *P. punctata* has been reported from Ohio. Records

show that *Cystobranchus meyeri* and *C. verrilli* are uncommon and more restricted in distribution.

Piscicola geometra, a common European species, has also been reported from North America. Early reports of its being found in North America by Keith (1954) in Minnesota and Bere (1931) in Wisconsin must remain doubtful since the specimens are not available for verification. Klemm (1972a, 1972b) examined specimens which resembled this species and based on his observations reported it from Michigan. Oliver (1958) reported it from Saskatchewan and Davies (1973) recorded it from Ontario and Quebec in Canada. Davies (1973) reported that this holarctic species appears more widely distributed than was previously considered. Sawyer (1972), however, reported that the occurrence of *P. geometra* in North America is still open to question. Some reports of *P. geometra* may have been a geographical variant of the species, *P. milneri*, (see Taxonomy).

In the family Erpobdellidae two species, *Erpobdella punctata* and *Mooreobdella fervida*, are very common and locally abundant (Table IV). *Mooreobdella microstoma* also appears common and locally abundant; it is especially common in the southern states. *Dina parva* and *D. dubia* are relatively uncommon but may be locally abundant; both are considered to be northern species. *Nephelopsis obscura* is widely distributed and restricted to areas of northern United States and Canada.

Table V shows that *Macrobdella decora* and *Haemopis marmorata* are widely distributed and among the Hirudinidae are the most often encountered. *Haemopis grandis* appears common but is widely distributed and may be locally abundant. *Haemopis plumbea* and *H. terrestris* appear more restricted and uncommon. The distribution records of *H. plumbea* for Ontario, Michigan, Ohio, and Wisconsin are questionable (see Taxonomy). *Haemopis lateromaculata* is uncommon and may not be found in the Great Lakes region proper; it has only been reported from the southwest corner of Minnesota and northwest Iowa (Mathers, 1963). *Philobdella gracilis* is very restricted in distribution in the Great Lakes region, reported from Illinois (Moore, 1901) and from a disjunct population in southern Michigan (Kopenski, 1969; Klemm, 1972a, 1972b, 1977); it is especially abundant in the southern states.

No new species have been discovered in this Great Lakes region study. However, *Actinobdella inequiannulata*, *Batracobdella phalera*, *Piscicola milneri*, *Piscicolaria reducta*, *Placobdella montifera*, and *Placobdella papillifera* from Pennsylvania; *Helobdella fusca*, *H. triserialis*, *Piscicolaria reducta*, *Glossiphonia heteroclita*, *Actinobdella*

inequiannulata from New York; and *Piscicolaria reducta* from Minnesota are new records for the respective states.

Summary

(1) The taxonomy of the freshwater leeches of the Great Lakes region and bordering states of Illinois, Indiana, Michigan, Minnesota, Ohio, New York, Pennsylvania, and Wisconsin and the Province of Ontario, Canada, are critically reviewed. In addition, distribution records considered valid and new distribution records are included for each species.

(2) Forty-three species were encountered: *Actinobdella annectens* Moore, 1906; *A. inequiannulata* Moore, 1901; *Batracobdella michiganensis* Sawyer, 1972; *B. phalera* (Graf, 1899); *B. picta* (Verrill, 1872); *Glossiphonia complanata* (Linnaeus, 1758); *G. heteroclita* (Linnaeus, 1761); *Helobdella elongata* (Castle, 1900); *H. fusca* (Castle, 1900); *H. papillata* (Moore, 1906); *H. stagnalis* (Linnaeus, 1758); *H. transversa* Sawyer, 1972; *H. triserialis* (E. Blanchard, 1849); *Marvinmeyeria lucida* (Moore, 1954); *Placobdella hollensis* (Whitman, 1892); *P. montifera* Moore, 1906; *P. ornata* (Verrill, 1872); *P. papillifera* (Verrill, 1872); *P. parasitica* (Say, 1824); *P. pediculata* Hemingway, 1908; *Theromyzon biannulatum* nom. nov.; *T. rude* (Baird, 1869); *Cystobranchus meyeri* Hayunga & Grey, 1976; *C. verrilli* Meyer, 1940; *Myzobdella lugubris* Leidy, 1851; *Piscicola geometra* (Linnaeus, 1758); *P. milneri* (Verrill, 1874); *P. punctata* (Verrill, 1871); *Piscicolaria reducta* Meyer, 1940; *Dina dubia* Moore & Meyer, 1951; *D. parva* Moore, 1912; *Erpobdella punctata* (Leidy, 1870); *Mooreobdella bucera* (Moore, 1949); *M. fervida* (Verrill, 1874); *M. microstoma* (Moore, 1901); *Nephelopsis obscura* Verrill, 1872; *Haemopis grandis* (Verrill, 1874); *H. lateromaculata* Mathers, 1963; *H. marmorata* (Say, 1824) Moore, 1901; *H. plumbea* Moore, 1912; *H. terrestris* (Forbes, 1890) Sawyer, 1972; *Macrobdella decora* (Say, 1824); *Philobdella gracilis* Moore, 1901.

(3) One new species is proposed: *Theromyzon biannulatum* nom. nov. for *occidentalis* (Moore, 1912), *nec* (Verrill, 1874), from Illinois, Michigan, Minnesota, and Pennsylvania. It is similar to *T. rude* and can be characterized by the following: eyes four pairs, equidistant, in two longitudinal rows; body gelatinous, translucent (globular and opaque in recently fed individuals), with many fine black chromatophores dorsally and ventrally; dorsum with six longitudinal rows of rather widely spaced pale-yellow spots, paramedial spots largest, but spots may vary; gonopores separated by two annuli.

(4) One species is synonymized: *Helobdella lineata* (Verrill, 1874), synonym of *Helobdella triserialis* (E. Blanchard, 1849).

(5) The distribution record of *Theromyzon rude* in the Great Lakes region is questionable.

(6) The occurrence of *Piscicola geometra* in the Great Lakes region (and in North America) is considered questionable.

(7) The distribution records of *Haemopis plumbea* for Ontario, Michigan, Ohio, and Wisconsin are questionable.

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ERRATA

Page 414, References, Daniels, B. A. 1976, read Daniels, B. A. and R. S. Freeman, 1976.

Page 415, References, Klemm, D. J. 1977, read 1978.

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